Chapter 32
Areas of Learning: The Shift Towards Work and Competence Orientation Within the School-based Vocational Education in the German Dual Apprenticeship System

Michael Gessler

32.1 Introduction

In Germany, the dual system of vocational education and training is carried out parallel in companies (normally 3 days a week) and in vocational schools (normally 2 days a week). There are statutory regulation documents for the goals, content and timetable structures for the vocational education and training at the two learning locations: The companies are governed by *training regulations* and the vocational schools by *framework curricula*. There is no regulation that incorporates both (e.g. an integrated training and education plan) or is equally valid for both learning locations due to the federal structure of Germany and jurisdiction being shared between federal government and state government.

The federal government is responsible for training regulations (usually the Federal Ministry for Economics and Technology) based on the German Vocational Training Act of 1969 (amended in 2005; covering among others the following apprenticeship trainings: industrial clerk, information technology specialist) or based on the Crafts Code of 1953 (amended in 2004; covering among others the following apprenticeship trainings: electronics technician, carpenter). In accordance with Section 5 of the German Vocational Training Act or the Section 26 of the Crafts Code, the following five points must be established in a training regulation:

- Name of vocation and recognised apprenticeship training
- Length of vocational education and training (as a general rule, no longer than 3 years and no shorter than 2 years)
- Vocational profile/training objectives (vocational skills, knowledge and abilities)

M. Gessler (✉)
Institute Technology and Education (ITB), University of Bremen, Bremen, Germany
e-mail: mgessler@uni-bremen.de

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- Structure of the apprenticeship/training framework (plan that includes content and timetable for passing on vocational skills, knowledge and abilities)
- Examination requirements

The vocational schools' curricula are made for the 16 states (Länder) by the 16 states' Ministries of Education. This means: There are currently approx. 330 recognised apprenticeship trainings with approx. 330 federal training regulations (first pillar) leading to 330 vocations. Due to the states' jurisdiction over their own education policies, each state could therefore theoretically issue its own curriculum (second pillar) for the school-based vocational education ($330 \times 16 = 5280$). This approach consumed in the past an enormous amount of time for each state (Land) and led to different school-based vocational education in the various states. For this reason, the following system has been established: new and further development of curricula for vocational education in schools are coordinated by the Standing Conference of the Ministers of Education and Cultural Affairs (KMK), a voluntary coordinating body for the 16 state ministries without constitutional status (first congress in 1948). The developed curricula, so-called KMK framework curricula, are subsequently adopted by each of the state ministries (usually without applying any further changes). The new and further development of training regulations for vocational training in companies on the other hand is carried out by the Federal Institute of Vocational Training (BIBB; founded in 1970) on behalf of the Federal Ministry.

Although there is no single regulation for the two learning locations, in 1972 there has been a formal agreement between the Federal Government and the KMK (or state governments). This agreement specifies that the new and further development of training regulations and the new and further development of a KMK framework curricula are coordinated alongside one another and together with the relevant experts responsible for the regulations' new and further development. The experts from the Federal Institute of Vocational Training (BIBB) are generally representatives of employers' and employees' associations. That means that the training regulations for companies are developed by industry or craft representatives. The KMK's experts, on the other hand, are generally teachers from vocational schools. Table 32.1 provides an overview outline of the structure of the dual system of vocational education and training in Germany.

The formal administrative agreement of 1972 constituted an important step in overcoming the formal duality of jurisdictions. The agreement was a necessary step for integrating the separate jurisdictions into one combined system and for it even to be called a dual system. It was a necessary step, but it was not wholly sufficient. Up until the mid-1990s, one key problem was that the training regulations and the framework curriculum did not fit with one another in terms of content and objectives. The respective system logics were just too different, with the acquisition of practical and applicable know-how on the one hand (companies) and abstract and systematic theoretical knowledge on the other (schools).

Since the concept *areas of learning* (German = Lernfeldkonzept) was introduced in 1996 as a structural principle for the KMK framework curricula, the requirements for vocational education in schools had to be redefined. The reform ended up being

Table 32.1 Jurisdictions in the dual system of vocational education and training

	Dual system of vocational education and training for approx. 330 recognised vocations		
Learning location	Company		School
Jurisdiction	Federal government		State government
Statutory basis	Industry	Craft	Individual federal states' education acts
	Vocational Training Act	Crafts Code	
Focus	Vocational training		Vocational education
Regulations	Training regulations		Framework curriculum
New and further development of regulations	Federal Institute for Vocational Training (BIBB)		Standing Conference of the Ministers of Education and Cultural Affairs of the Länder (KMK)
Appointed experts	Industry and craft representatives		School representatives (teachers)
Solution of separated jurisdiction	Joint agreement since 1972 between the federal government and the KMK/state governments on coordinating training regulations and framework curricula		

much less of an evolution rather than a revolution. The reform had wide-ranging consequences not only on the course and lesson design but also on the organisational framework conditions of the schools, the cooperation between schools and companies and the required qualification profile of the teachers.

In the school-based vocational education, the reform removed the concept of subjects and replaced them with areas of learning. The core tasks of the reform are (Bader and Schäfer 1998):

- Outcome orientation using 'vocational spheres of activity': The key goal of vocational education is no longer the orientation to reference (scientific) disciplines corresponding with subject logic (e.g. engineering, mathematics) but the orientation towards vocation-based work requirements or vocational spheres of activity. Learners are to be given the tools to tackle the vocational spheres of activity in companies, which are interrelated complex tasks important to the vocation and work in companies, but also personal and social life. Vocational spheres of activity are always multidimensional by linking together technical, social and personal problem tasks. The weighting between the dimensions may vary. A distinction between these three dimensions only serves analytical purposes.
- Process orientation using 'areas of learning': The school-based curriculum is no longer structured in subjects but constructed into work-oriented and process-related areas of learning. Areas of learnings are didactically founded equivalents of vocational spheres of activity that are handled at school. They are made up of complex tasks, which are then handled pedagogically using action-oriented learning situations. Areas of learning are target formulations in the context of competence descriptions and are specified through content summaries.

- Action-orientation using ‘learning situations’: Through the use of learning situations, vocational areas of learning are specified as complex teaching-learning arrangements that should require vocational actions, promote reflection and facilitate the accrual of applicable know-how. Learning situations put areas of learnings in concrete terms. Learning situations are developed in educational conferences by a team of teachers. The arrangements are work-oriented but didactically realised in the classroom and are accompanied by didactic reflection relevant to the vocation as well as individual and social life.

Since the mid-1990s and the introduction of the new concept, vocational education has experienced a work-oriented and competence-based turn. Its intended direction is an approximation of school-based learning to conditions within the marketplace. Various theories and development trends were taken up in this regard, such as action-theoretical approaches (Aebli 1980), the process orientation of lean management (Womack et al. 1994) or other reflections on situated knowledge and learning (Lave 1988; Lave and Wenger 1991).

The competence turn occurred one decade later and in the opposite direction within general education: an approximation of school-based learning to the systematics of the reference disciplines. These two differing directions are described in the following section of this chapter.

32.2 Concepts of Competence-based Education

There are today different approaches to competence-based education within the general educational schooling system and vocational education and training system in Germany. The emergence of these differing concepts, their differing backgrounds and diverging understanding of concepts are demonstrated in the following two subsections.

32.2.1 Work Orientation Versus Science Orientation

The discussion about whether vocational education in vocational schools required a new foundation initially started in Germany in the 1980s. The competence-based turn in vocational education finally took place in the 1990s. Since 1991, the ultimate goal of vocational education has been *competence to act*. This ultimate goal led to the formulation of an action-oriented education as a didactic guiding principle (KMK 1991). Then came the curricula change in 1996; until 1996 all content matter at vocational schools had been taught systematically. Since 1996, the content matter is no longer oriented to the reference disciplines (e.g. engineering) but to the actual work requirements (KMK 1996/1999). In the future, trainees should learn how to master vocational and professional challenges also within the school setting. The classic distinctions of 'theory equals school-based learning' and 'practical experience equals work-based learning in companies' or 'knowledge equals school-based learning' and 'know-how equals work-based learning in companies' are to be removed through the orientation of school-based content to the practical requirements of the vocational and professional work. It is no longer the inputs (useful knowledge) but rather the outputs (holistic vocational activities structured into areas of learning) that are defined. The reform introduced a work-centred turn in the school-based component of dual vocational education and training. The reform was triggered during the 1980s by companies' heavy criticisms of the school-based education as useless for the work requirements and the needs of the companies (Gerds 2001).

In the 1990s, the general education system had to prioritise a different task: the new federal states (previously the German Democratic Republic aka East Germany) of reunified Germany had to adapt and/or build up from scratch their general education system to introduce and stabilise the new form of society (social market economy rather than socialism). The 'old' Federal Republic of Germany supported this reconstruction with its three-tiered school system of Hauptschule (secondary general school), Realschule (intermediate secondary school) and Gymnasium (grammar school), stemming from the Weimar Republic (1918 to 1933) and therefore somewhat antiquated by then. The competence-based turn took place in the general educational school system a decade later, from 2001 onwards. This time it was not the industry that triggered the change but the bad results (from a German perspective) of students compared internationally as part of the Programme for International Student Assessment (PISA) carried out by the Organisation for Economic Cooperation and Development (OECD). Initially the PISA results triggered a state of shock in the general educational school system, which then led to a wave of reforms. Only very little would presumably have occurred after the physical exertion in the 1990s without this impetus from outside; the general education system had already restabilised itself and was back to normal. The OECD/PISA feedback only affected the general education school system, not the dual vocational education and training system. The vocational education within the dual system had distanced itself from the scientific concept and introduced the action principle oriented towards skilled labour. In the 2000s, the key task for vocational schools within the dual system was on how to make complex vocational-operational tasks accessible in a school-based learning setting and how these could not only be experienced theoretically and reflectively but also oriented towards practice and experience.

The reforms in the general education systems, on the other hand, were targeted at strengthening the scientific principles: 'Subjects taught correspond with scientific disciplines that develop particular world views (historic, literary-cultural, scientific etc.), while introducing particular 'codes' (e.g. mathematical models, hermeneutic text interpretation)' (Klieme et al. 2003, p. 18, translated from German by the author). In the 2000s, especially, representatives of educational psychology and subject didactics in general education design competence models with structural models on the one hand and level stage models on the other, oriented by traditional profiles (including linguistic/literary, mathematical/scientific, historic/social and aesthetic/expressive). Common to both paths is that the outcomes are placed in the fore. How the two education systems are managed (vocational education and general education) is oriented towards the question of what somebody should ultimately be able to do. The important difference between the two is what guiding paradigm their competence is based on.

- Science, systematic and subject orientation in general education: In order to apply and transfer knowledge, it must be ordered systematically and should therefore be taught and learned systematically. Developing this systematic behaviour is the key role within the scientific discipline and subject didactics. The teachers' responsibility is to solidify the subject-structured content (e.g. mathematics, physics) in class using various social applications (e.g. 'You would like to conclude a mobile phone contract…').
- Work, situation and action orientation in the dual VET-System: In order to apply and transfer knowledge, it should be situated and should therefore be taught and learned using situated vocational and professional problems. The professional problems are provided using operational requirements or a job's action logic (where action logic is expressed in actual business and work processes). The responsibility of the teachers at the schools is to incorporate the vocational and professional problems indicated on the framework curriculum into learning situations for class (e.g. for the career of Electronics Technician: 'You would like to install a satellite dish at a private household…').

The challenges can vary accordingly: while, for instance, mathematics is basically identical across cultural borders (and is therefore particularly suited for international comparisons), vocational and professional skills do not reflect a single dimension, but are always related to relevant cultural, political, organisational and situational requirements. Accordingly, a comprehensive definition of competence is needed in vocational education and training, which considers not only the technical competence but also the social and personal (self) competence. In this context, mathematical competence is just a subsegment of technical competence and may, for instance, be mostly useless without know-how and social and personal competence in work-related situations (e.g. 'How would I justify a decision to a customer?'). However, mathematical competence is a standalone competence in general education that can be structured (e.g. mathematical argumentation, mathematical modelling, mathematical representations) and scaled (e.g. reproduction, generalisation, reflection).

Table 32.2 illustrates as an overview of the key differences between competence-based education in the general education and in the dual system of vocational education and training (see also Sloane and Dilger 2005).

In vocational education and training, the concept of work-oriented competence currently holds about as much sway in Germany as the little Gaul village used to in Ancient Rome. It does not fit into the national context of general education, and it does not fit into the international OECD/PISA context. The 'little Gaul village'

Table 32.2 Competence-based education in general and vocational education

Characteristic	Competence-based orientation in Vocational education	 General education
Principle of control (old)	Input orientation	Input orientation
	Purpose in schools: Acquisition of systematic knowledge	Purpose in schools: Acquisition of systematic knowledge
Trigger	Criticism by the industry: The school-based vocational education does not contribute to meeting vocational and professional challenges but only provides abstract and useless knowledge	PISA comparison study by OECD: Performance by German pupils is only average when compared internationally
Begin	1990	2000
Principle of control (new)	Outcome orientation	Outcome orientation
	Purpose: Meeting vocational and professional challenges	Purpose: Meeting subject challenges
Guiding paradigm	Vocation and work	Science and subject
	Situated	Systematic
Competence	Competence = Integration of differing skills and abilities in order to perform successfully within a specific domain	Competencies = Sum of various cognitive abilities with different qualitative levels in order to solve problems in a specific domain
Domain	Definable vocational sphere of activity (e.g. mechatronics)	Subjects (e.g. mathematics)

comparison is also quite applicable, because the concept of work-centred competence and the concept of areas of learnings only concern the dual system of vocational education and training in Germany. Besides this education and training option in form of a part-time vocational school (in the dual system, the school-based education takes place as mentioned on 2 days), in Germany exists also the option (in particular in the field of personal services provision, e.g. health care) to complete a fully school-based vocational education and training. In short, the work-centred competence-based turn only took place in the subsystem of 'vocational education' within the German education system and even here only in the subsystem 'dual system of vocational education and training'. A further analogy to our Gauls is that they enjoy a high level of sympathy. In a similar fashion, the German dual system of vocational education and training enjoys great international esteem, as this system is obviously both capable of achieving societal goals (for instance, a low unemployment rate) and economic goals (e.g. high economic power) according to the OECD (2010). These findings were made by the OECD, in other words, an organisation supporting a concept of competence not shared by the dual system of vocational training and education in Germany. To understand the conceptual differences, a deeper insight into the two competence-based approaches is required.

32.2.2 *Competence to Act Versus Cognitive Competencies*

In order to clarify the difference between the (reduced) concept of competence in general education and the (extended) concept of competence in vocational education and training, initially one should outline the concept of competence in general education.

32.2.2.1 Cognitive Competencies as the Key Concept of General Education

The normative foundations for reforms and competence-based education in the general education system were laid out in 2003 in the expert opinion 'to develop national education standards' (Klieme et al. 2003). Its logic consists of the following:

1. Educational goals (Bildungsziele) are only generally accepted statements and only reflect general expectations. They must therefore be put in concrete terms using competence requirements (Klieme et al. 2003, p. 20).
2. As part of a second step, Franz E. Weinert's comprehensive definition of the competence concept is used (ibid., p. 21 and p. 72), wherein competences are understood as 'the cognitive abilities and skills that individuals possess or can learn for solving specific problems, and the associated motivational, volitional and social readiness and abilities that enable them to use these solutions responsibly and successfully in a variety of situations' (Weinert 2001, pp. 27–28, translated from German by the author).
3. The next step introduces the premise of domains; here domains are equated with subjects. A distinction is drawn then between 'subjects' and 'non-subjects' (including personal and social competence) that are afterwards declassified as formless 'cross-disciplinary competences': 'Research would indicate that the development of cross-disciplinary competences assumes that extensive subject-based competences must already be in place' (Klieme et al. 2003, p. 75, translated from German by the author).
4. Following this division and categorisation, the conclusion is drawn that the formulation and the operationalisation of the competence concept ought to occur in a *subject*-specific way and that it would therefore be the responsibility of science-oriented subject didactics (or in English, science-oriented pedagogical content knowledge, PCK) to define competence models (ibid., p. 75).

Which logic is being applied here? The board is initially wiped clean. The arduous concept of 'Bildung' is rejected. Which understanding is thereby being pushed aside? The German Committee for Education (Deutsche Ausschuss für das Erziehungs-und Bildungswesen) used to define 'Bildung' in the 1960s as follows: 'Being educated means you are constantly attempting to better understand yourself, society and the world around you … it is not the brain that is educated, but the whole person. … education rests considerably on an individual's own experiences … Being educated means listening and the ability to participate in discussion. … education is the ability to independently perform critique and critical trust' (Bohnenkamp et al. 1966, pp. 870–873).

The blank board is now refilled with Weinert's definition (see above). Nonetheless, Weinert's definition is also too wide-sweeping (in other words, social readiness and skills, responsible use of one's abilities), which is why it needs to be reduced further to make it one-dimensional measurable. At the end, only a fraction of Weinert's comprehensive understanding of competence remains: 'Competence' equals 'specialised competence', with the word specialism referring to a domain and domain being a teaching subject. The authors of the expert opinion 'to develop national education standards' therefore make an explicit distinction as to the comprehensive understanding of competence: 'The term competences used here should be expressly distinguished from the concepts that hail from vocational education and training and are frequently also used in public for technical, methodological, social and personal competence' (Klieme et al. 2003, p. 22, translated from German by the author).

32.2.2.2 Competence to Act as the Key Concept of Vocational Education and Training

In 1991, the Standing Conference of the Ministers of Education and Cultural Affairs (KMK) passed a framework agreement for the vocational schools: Vocational school provides a vocational basic and specialised education and thereby extends the previously acquired general education. This should enable a person to fulfil their challenges in the workplace as well as participate in shaping the working environment and society around them with social and environmental responsibility. Vocational school aims to provide the vocational skills by combining technical competence with general competence such as human and social competence (KMK 1991; see also Rauner 1988). The triad of competences (technical competence, human competence and social competence) has a long tradition in Germany (Roth 1971). Before introduction of the concept areas of learning, it already formed a central basic idea within vocational education and training. This concept was seized up again within the areas of learning concept and summarised with the term 'competence to act': Part of the vocational school's aim is to impart vocational competence to act and extend the general education (KMK 2011). Competence to act comprises the dimensions of specialised technical competence, self-competence and social competence. On one hand, these dimensions are dependent, interconnected and cannot be developed independent of one another. On the other hand, these dimensions provide reference points and can be considered separately in order to pay attention that the three dimensions are demonstrated sufficiently. The three competence dimensions of competence to act can be defined as follows (Bader and Müller 2002):

- *Technical competence* is the ability and readiness to handle tasks independently, technically correctly and finally assess the outcome. This also involves extra-functional skills such as logical, analytical, abstract, integrated reasoning as well as the recognition of interconnected systems and processes. Regarding the training regulations for vocational education and training, corresponding specialist competence corresponds with the objective of enabling the performance of a vocation that involves independent planning, implementation and monitoring in particular.
- *Self-competence* describes the ability and readiness of a person to clarify, reflect on and assess for themselves the developmental opportunities, requirements and restrictions of work, family and public life, develop their own talents as well as conceive and develop their own life plans. Among others, this also entails developing well-thought-out moral values and a self-determined commitment to specific values.
- *Social competence* describes the ability and readiness to conceive and comprehend social relationships and interests, affection and tension as well as reason and communicate with other people rationally and responsibly. This also involves the development of social responsibility and solidarity.

The three dimensions are emphasised using three transversal types of competence. These three types of competence – communicative competence, methodological competence and learning competence – are not independent dimensions but emphases within the three abovementioned dimensions. The three accentuating competences can be defined as follows (Bader and Müller 2002):

- *Communicative competence* refers not only to the ability and readiness to share with one another issues and feelings via verbal (spoken and written) and formal (formulaic, visual) languages but also through non-verbal means (gesticulation and facial expression). This also encompasses the ability to perceive, understand and express one's own intentions and needs and those of others. The objective is therefore to understand and shape communicative situations.
- *Methodological competence* describes the ability and readiness to proceed in a targeted and planned manner when handling vocational tasks and problems (e.g. when planning the process steps). Here learned thinking methods, procedures and solution strategies are independently selected, applied and, where necessary, developed further in order to handle tasks and problems. Methodical work includes independent design and assessment, which require initiative and creativity.
- *Learning competence* is the ability and readiness to comprehend, evaluate and integrate into their thought processes information regarding specific issues and relationships independently as well as together with others. In terms of professional work, learning competence develops through the mental processing of technical illustrations (sketches, wiring diagrams, professional articles), as well as in the comprehension and interpretation of social relationships and actions found in documentation by certain groups (newspaper reports, magazine articles, films, etc.). Importantly, learning competence also involves the ability and

readiness to develop and use in their further development learning techniques and strategies within and going beyond the vocational area.

This comprehensive concept of competence forms the basis for the concept areas of learning and the work-centred turn in vocational education in the dual system of vocational education and training. From this basis, the next step is to consider the development of the concept of areas of learning in its historic setting.

32.3 Design Principles of Vocational Curricula

A key question when developing curricula is to decide how to orient the objectives, content and methods and how to justify their relevance. Two major changes occurred: from work orientation to science orientation (in the 1960) and back with the reform in 1996 to work process orientation.

32.3.1 From Work Orientation to Science Orientation

At the beginning of the twentieth century in Germany, the purely vocational training system was complemented by a second pillar, school-based vocational education, ensuring that adolescents learn to (1) dutifully perform a vocation, (2) in order to take up a societal function using their profession, (3) thus stabilising their imperial state as dutiful citizens (Kerschensteiner 1901). According to Georg Kerschensteiner (founder of the vocational schools in Germany), such school-based vocational education would have to be grounded on work, not purely theory: ‘Crafts are not just the basis of all art but also the basis of any real science. A public school designed to prepare for intellectual and manual professions is badly organised if it does not offer any facilities to develop the practical inclinations and abilities of a pupil.’ (Kerschensteiner 1911/1922, p. 28, translated from German by the author). Education should therefore be geared towards practical interests and skills. Its model example is the autonomous master craftsman. With this educational concept, Kerschensteiner creates a fundamental idea, which has had a sustained impact on vocational education and training in Germany and, despite the later-mentioned orientation towards the scientific principle, has always remained as the fundamental consensus of vocational education and training (Gessler and Howe 2013).

In the beginning of the 1960s, the professionalisation of school-based vocational education and training in the technical area finally also reaches the teachers. The provision of teacher education then switched from the pedagogical institutes to universities, which also meant the entrance requirements changed. Instead of vocational education and training in connection with a further vocational training, the general educational Abitur (equivalent to A levels in the UK, BAC in France, high school level in the USA) and a short industrial internship were now preconditions to enter teacher training. Subsequently, technology-oriented students of teacher education particularly attend engineering courses and commerce-oriented students of teacher education particularly attend economy-related courses. Key model examples are the academically qualified ‘Diplom-Ingenieur’ (Master of Engineering) or the similarly academically qualified ‘Diplom-Kaufmann’ (M.Sc. Business Administration). The universities’ concept of being academically oriented rather than practice-oriented has been socialising this generation of teachers at vocational schools until today (Lipsmeier 1998).

In 1970, the German Education Council (a commission founded in 1965 by the Federal Government and the state governments that operated from 1966 to 1975) published recommendations for teacher education. These were as follows: (1) the principle of science orientation, ‘the scientific orientation of subject matter and learning method is valid for all age groups’ (Deutscher Bildungsrat 1972, p. 33), and (2) the principle of rationality, ‘Besides the learning objectives and contents, the curriculum also determines the respective orders and learning steps as well as the various methods, materials and educational technologies. The learning objectives must be monitored’ (ibid., p. 63). The recommendations strengthen the already-existing scientific principle, which is why in their vocational schools the academically trained teachers find a curriculum consisting of subject areas, narrowly formulated learning objectives and extensive content catalogues.

Table 32.3 provides, for example, purposes of an excerpt from a vocational school curriculum in 1983, specifically for a construction material tester class (Tenberg 2006). This example clearly demonstrates the compartmentalisation of objectives and units of time, the scientific orientation of the content detached from

Table 32.3 Vocational education and training curriculum from 1983

Learning objectives		Learning content	Methodological teaching notes	Time
1.4 Mass, density, force				
1.4.1.	Knowledge of the laws between mass, density and volume	Practical problem examples: determining the mass, density and volume of construction materials, e.g. a concrete part’s bulk density	Only use SI units See textbook ‘Praktische Fachkunde’ (practical skills), section 1.2	3 h
	Ability to perform technical calculations			
1.4.2.	Overview of the effect of forces	A force’s changes of motion, position and shape, magnitude, direction and line of action	Examples demonstrations of a force’s effect Force measurement using a spring balance	1 h
	Ability to illustrate forces graphically	Force vector, force measurement scale, point load, surface load	The loading assumptions (dead weight, live load) according to DIN 1055 and DIN 1072 are only to be taught generically and in simplified form	

any operational purpose (thus therefore highly systematic) and the detailed methodological teaching notes. Such detailed guidelines could lead to asking whether professionalism were even required for teaching such material. Instead it brings up the image of an 'extended work bench'.

The scientific principle, as in the primacy of scientific content and scientific rationality, management and control, has become widely established and is set up and integrated across the board, from higher education, across curricula and to the lesson structures in a 45-min cycle. It just had one drawback: The industry had become dissatisfied with the development and particularly the outcome. And there was another competitor: the situation principle or the original idea of situated and action-oriented practical learning.

32.3.2 From Science Orientation to Situated Areas of Learning

During the 1980s, school-based education within the dual system of vocational education and training saw heavy criticisms. The industry's representatives particularly criticised that the school-based education was too theory intensive and far from reality, not contributing towards tackling the challenges of working life in the industry. In other words, the schools were not oriented towards the customer (Gerds 2001; Hüster and Gravert 2001).

Initially, Germany's Federal Institute for Vocational Training (BIBB) and its industrial social partners reacted to the growing critique with the upcoming reorganisation of metal and electrical vocations between 1987 and 1989. One key component of the reorganisation was that self-governance (the personality principle) as the ability for autonomous planning, autonomous implementation and autonomous monitoring was back in focus. As a consequence, the in-company practical examination was also modified: while previously only a job's final outcome was assessed, now an examinee's skills demonstrated in situ are assessed additionally to the outcome. The commission working in parallel to develop the teaching curricula for metal and electrical engineering also orient themselves according to the principle of personality. Their shared orientation was the model example of 'autonomous action'.

Shortly afterwards, in 1991, the Conference of the Ministers of Education and Cultural Affairs passed a framework agreement for vocational schools, setting decisive parameters. The vocational school's objective would be to provide a vocational basic and specialised education and extend the previously acquired general education. The vocational school aims to provide the trainee with the abilities to fulfil their vocation socially and ecologically responsibly and participate in shaping their working environment and community (KMK 1991).

In 1992, the KMK reacted once more to critique against vocational education and appointed a commission to revise the 'recommendations for the preparation of KMK framework curricula'. The commission submitted its first output in 1996. This was first tested in individual vocations and then passed as a binding basis.

What exactly are the recommendations that were compiled by the commission? The 'recommendations' describe how KMK framework curricula are developed, how they should be designed and what they should contain. Particularly the school-based vocational education is formulated and the guideline is laid down that KMK framework curricula are to be structured using areas of learning. Because the KMK framework curricula are mostly adopted by state ministries directly as curricula, these recommendations directly influence the education at the vocational school.

The new concept of 'areas of learning' does not completely abolish the dominant scientific principle of the mid-1990s, but it did introduce the situational principle, and the concept included above all that the scientific principle starts to fulfil a kind of service provider function for the situational principle: 'Areas of Learning are … thematic units that are oriented towards vocational tasks and procedures. In special cases, thematic units can also be included within areas of learning from an academic point of view. In any case, even for such units the connection with the work process should be made clear. Conveying orientational knowledge, system-oriented thinking and action, solving complex and example tasks as well as networked thinking are promoted particularly within an action-oriented classroom. It is therefore indispensable that the respective work and business processes are provided with the relevant academic background information' (KMK 1996/1999, p. 14).

Viewing the situational principle and the scientific principle as mutually exclusive would be of very little benefit to learning (Kremer 2003). Both principles possess different strengths. However, both principles also possess weaknesses, which could be compensated with the other respective principle's strength. The scientific orientation, for instance, enables the development of a well-structured knowledge base and thereby promotes the ability to reflect systematically; however, thereby neglecting the procedural and practical significance and applicability of the knowledge. The situational principle, on the other hand, promotes the situated applicability of knowledge and the development of personal and social competences, but this principle does not provide a systematic structure for this knowledge, which may prove problematic in the case of deeper professional reflection. A central question is also if problematic new actions need a different kind of knowledge as routine actions (Nickolaus 2014). The art consists of intermingling the two principles with one another. However, the normative basis of this new approach to education with vocational spheres of activity is shaped largely by the situational principle. What is overlooked here is the importance of other predictors such as previous and explicit technical knowledge, mathematical and linguistic prerequisite, general cognitive abilities, motivation, and interest in the apprenticeship training and vocation (Lehmann and Seeber 2007; Nickolaus 2013).

Up until 1996, the framework curricula were structured according to areas of learning. The following excerpt from KMK framework curricula for industrial metal-working vocations from 1987 to 1996 demonstrates the old scientific principle and the structure according to engineering subjects. Afterwards and in contrast, a curriculum (Table 32.4) following the new concept will be presented.

Table 32.4 Framework curriculum for the recognised vocation of industrial mechanic

No.	Learning areas	Approximate time scales in hours			
		1st year	2nd year	3rd year	4th year
1	Production of components using hand-held tools	80			
2	Production of components using machines	80			
3	Manufacture of simple assemblies	80			
4	Maintenance of technical systems	80			
5	Production of parts using machine tools		80		
6	Installation and commissioning of control systems		60		
7	Fitting of technical subsystems		40		
8	Manufacture using numerically controlled machine tools		60		
9	Repair of technical systems		40		
10	Manufacture and commissioning of technical systems			80	
11	Monitoring product and process quality			60	
12	Maintenance of technical systems			60	
13	Ensuring the operation of automated systems			80	
14	Planning and implementation of technical systems				80
15	Optimisation of technical systems				60
	Overall (total of 1020 h)	*320*	*280*	*280*	*140*

- Basic education:
  - Introduction to manufacturing and testing engineering (120 h)
  - Introduction to materials engineering (20 h)
  - Introduction to machine and device engineering (20 h)
  - Introduction to control and information technology (60 h)
  - Introduction to electrical engineering (20 h)
  - Introduction to technical communications (80 h)
- Technical education (e.g. industrial mechanic, 2nd year of training):
  - Manufacturing and testing engineering (80 h)
  - Materials engineering (40 h)
  - Machine and device engineering (20 h)
  - Electrical engineering (20 h)
  - Control engineering (40 h)
  - Technical communications (60 h)

A mechanical engineer's (academically trained in higher/university education) task is to develop and construct machines. The task of a skilled worker (vocationally trained in the VET system), on the other hand, is to operate, maintain or repair machines. This demand manifests itself in the areas of learning structured framework curriculum of 2004 (Table 32.4), not in the above old curriculum following the scientific principle.

The following and final section will attempt to explain how this guideline can help design vocational education in the classroom. Here the framework curricula provide little support – and for good reason.

32.4 Pedagogical Foundations and Work-Process Orientation

As a first step, statutory regulations for the pedagogical foundations in the classroom will be presented. Here it becomes apparent that the teachers are only given a general framework as an orientation for their teaching with pedagogical foundations, rough descriptions of areas of learning as well as approximate time scales (study hours). According to the new concept, the framework curricula no longer contain concrete methodological teaching notes. In a second step, starting from the analysis of vocational and professional working processes, it should be demonstrated how a teacher can design the vocational education at a vocational school.

32.4.1 Pedagogical Foundations

Since 1991, it has been the objective of vocational education and training to provide trainees with the skills to autonomously plan, implement and assess work tasks in the context of their vocation (KMK 1991). This goal already existed, previously indicated, at the beginning of the twentieth century with the orientation towards the master craftsman. In the introduction of Taylorist working forms and the growth in industrial importance, the model example of the education moved towards the subservient employed worker. Since 1991, the aim has once more become to promote autonomy, independent of whether a person is employed or not. Such an aim requires education that promotes autonomy. The framework curricula do not name any concrete teaching methods or how such education should be implemented, but in each framework curriculum's introduction, the following points are mentioned for orientation in standardised form.

- Pedagogical points of reference are situations that are important for carrying out the vocation (learning for action).
- The learning basis comprises actions, ideally performed oneself or at least mentally comprehended and understood (learning by doing).
- Actions must be planned, implemented, monitored, where necessary corrected, and ultimately assessed by the learner, preferably autonomously.
- Actions should promote a holistic understanding of the professional reality, e.g. contain technical, safety-related, economic, legal, environmental or social aspects.

- Actions should be integrated with the learners' experiences and should reflect their social impact.
- Actions should also include social processes, for instance, declarations of interest or conflict resolution.

Apart from these orientation points, the education is now only framed by the provision of a brief description of the areas of learning with keywords on the contents. Area of Learning no. 13, 'Ensuring the operation of automated systems', of the framework curriculum shown above, the extent of such a description will briefly be illustrated (Table 32.5).

Above, reference was made to the teachers following the old paradigm of scientific orientation as subservient. Under the new paradigm of work orientation aimed at promoting autonomy, a change took place in basic attitudes: only teachers who can work autonomously can provide a framework within their education which enables pupils to learn autonomy. It would be a considerable contradiction in the concept if the teachers required their pupils to be autonomous, while simultaneously behaving subservient in their own actions. There are also other important points that speak for removing teaching regulations. How can differentiated education be promoted when an educational method has already been prescribed?

Table 32.5 Exemplary area of learning description

<table>
<tr><td colspan="3">Vocation: Industrial mechanic</td></tr>
<tr><td rowspan="2">Area of learning no. 3</td><td rowspan="2">Ensuring the operation of automated systems</td><td>3rd year of training</td></tr>
<tr><td>Approximate time scale: 80 h</td></tr>
<tr><td colspan="3">Formulation of aim:</td></tr>
<tr><td colspan="3">Pupils ensure the operation of automated systems. For this they analyse automated systems by using technical documentation, also available in English</td></tr>
<tr><td colspan="3">With consideration of the prescribed procedure and the manufacturer's documentation, they develop solutions for process optimisation of individual subsystems</td></tr>
<tr><td colspan="3">In order to repair operating faults, they develop strategies to isolate faults, apply them and then eliminate the fault with due consideration for economic aspects</td></tr>
<tr><td colspan="3">The pupils modify systems and test, document and present their solutions. They pay attention to the necessary steps for vocational safety when dealing with manufacturing and handling systems</td></tr>
<tr><td colspan="3">They assess the economic and societal aspects of automation engineering</td></tr>
<tr><td colspan="3">Content</td></tr>
<tr><td colspan="3">Electropneumatic and electrohydraulic functional units</td></tr>
<tr><td colspan="3">Control</td></tr>
<tr><td colspan="3">Regulation</td></tr>
<tr><td colspan="3">Programmable controls</td></tr>
<tr><td colspan="3">Operating modes</td></tr>
<tr><td colspan="3">Sequential function chart, function block diagram</td></tr>
<tr><td colspan="3">Flexible handling systems</td></tr>
<tr><td colspan="3">Interfaces</td></tr>
<tr><td colspan="3">Maintenance regulations</td></tr>
<tr><td colspan="3">Safety equipment</td></tr>
</table>

How could holistic actions in class (planning, implementation and assessment) be initiated, if education were divided into small methodological substeps? And finally, how should pupils learn about participating in shaping their environment, if the teacher already prescribes the entire layout beforehand, as this in turn was given to him?

32.4.2 Work-Process and Business-Process Orientation

The book 'The Machine That Changed the World' first appeared in 1991 in German, and by the year 1994, the 8th edition was already published (Womack et al. 1994). The concept of 'lean management' was prevalent, and German companies and administrations were endeavoured to implement it. The new concept of areas of learning was developed at that time (1992–1995), and the responsible commission was made up of 'pragmatists', not of scientists. One would assume that these pragmatists were aware of the new concept. A key element of lean management was the orientation towards processes and turning away from functions. The areas of learning embodied the same development: an orientation towards working and business processes and turning away from subjects and functionalism. The traditional academic disciplines lost influence through this orientation. A new academic discipline in Germany called 'vocational sciences' (Howe and Knutzen 2011a, b) was attempting to fill the resulting gap. Their objective was to decipher the 'work process knowledge' incorporated in skilled work (Fischer 2000) in order to create the foundational content for the design of teaching/learning arrangements in the classroom in vocational schools.

Whenever a work process demonstrates a particular quality from a company's perspective, in other words, it shapes the company's profile (and for whose services the customer is paying), it becomes a business process. Support processes, on the other hand, provide the foundation for these business processes. Whether a work process constitutes a business process and therefore provides a use value depends on the reference: information technology, for instance, is a support process for a university and a business process for an IT provider. A requirement of vocational education and training is that the apprenticeship involves important and contextualised work processes. This requirement is embodied by the term 'business process'. An area of learning is by definition the didactically processed equivalent of a vocational sphere of activity, structured using business and work processes.

The above description of an area of learning (area of learning no. 13 for the industrial mechanic vocation) reveals that concrete work process steps are not listed. If teachers want to teach an area of learning in class, they must investigate the work process in the company for themselves (or in conjunction with other teachers or the students) in order to develop the area of learning.

In conclusion, the instrument of work process analysis is to be presented, because it embodies the work-oriented turn in vocational education and training on the one hand and on the other represents an instrument that enables the preparation of vocational education based on areas of learning in the context of this turn. A comprehensive demonstration on the entire process with supporting work materials is documented in the 'Kompetenzwerkstatt' series with a total of 10 volumes developed by Falk Howe and Sönke Knutzen between 2011 and 2015 (overall concept: Howe and Knutzen 2011c) and published by the Federal Institute for Vocational Training (BIBB).

Starting point is that the areas of learning as an intermediate reference are given in the KMK framework curriculum. What is missing in the KMK framework curriculum is on the one hand the vocational spheres of activity (relation to work) and on the other hand the learning situations (relation to classroom teaching). With the instruments of the vocational sciences (macro-level, sector analysis; meso-level, case studies; micro-level, on-site visits, interviews and workshops), the work process knowledge has been explored. The connection between the workplace and classroom teaching has, linking to this preliminary work, the following rough stages:

1. Identification of vocational spheres of activity:

   - Work processes are demonstrated systematically in form of a work process matrix using data from on-site observations as well as interviews with experts from various representative companies. Within a work process matrix, the work process is split into four stages: order clarification, planning, implementation and completion. Every stage is specified using five dimensions: (1) laws, regulations, standards, (2) company conditions and rules, (3) customer requirements, (4) work steps and methods and (5) work objects.
   - Work processes that feature a logical connection are clustered together: the work process matrices are integrated. Previous research has shown that a job typically comprises between 12 and 15 of such clusters. A cluster may contain many less-extensive or few extensive work processes. Each cluster forms a vocational sphere of activity.
   - Parallel to the previous steps or following these two steps, moderated workshops lend themselves to better group these work processes into vocational and professional action sphere by providing different perspectives or to subsequently validate the resulting vocational sphere of activity in communication.
   - A description is drawn up for each vocational sphere of activity that comprises the following aspects: (1) typical orders; (2) typical work flow (work process steps); (3) curriculum, reference to the existing KMK framework curriculum; (4) vocational competence needed with two dimensions: (4a) work process phases (order clarification, planning, implementation, completion) and (4b) required competence to act in each phase (with the sub-dimensions technical, methodical, social-personal competence); and (5) trends in the vocational sphere of activity.

2. Planning and implementing learning situations for school-based vocational education

The next step comprises developing as a teacher team a vocational learning situation for the classroom using the information available (vocational sphere of activity with reference to the framework curriculum). This stage comprises the following steps (according to Berben 2006, p. 372 ff.; see also Bader and Schäfer 1998; Kremer and Sloane 2001; Howe and Knutzen 2011c):

- Analyse areas of learning: Which key goals are formulated in the area of learning (framework curriculum)? Which vocational and cross-vocational thematic areas do the area of learning focus on? What relationship can be seen between the area of learning and the vocational sphere of activity?
- Specifying a vocational sphere of activity for class: Which work process steps or rather work process stages should the learning situation's focal areas fall on? Which working tools and methods and which elements of the vocational competence to act are important to the learning situation within the area of learning?
- Description of task and learning situation: Which task is exemplary and relevant for the underlying vocational sphere of activity? Is the task suitable to the developmental level of the learner in terms of complexity, requirements and scope? Does the task allow for various solution possibilities? Can the task be carried out at school? What is the wording of the task for the students?
- Specify the key promotional areas: In concrete terms, what are the focal areas for competence building within the learning situations? What is the key content to be processed within the task set?
- Establish the required resources for the learning situation: What kind of environment is required for implementation of the learning situation? Which key subject matter is required for the learning situation?
- Clarifying the necessary conditions for learning and determining the amount teaching required: Which competences are needed to tackle the task and what competences do the students already possess? Can the gap be closed through self-organised learning or do supplementary subject-oriented educational units need to be planned in? When are these subject-oriented educational units to be implemented in concrete terms?
- Implement the learning situation and supporting reflection on acquired experiences: How, when and who presents a customer order? How can all the phases of the learning activity (order clarification, planning, implementation and completion) be accompanied supportively? How can the social learning processes be supported through the teacher's actions? How can reflection be initiated in the learning process and when should these reflection phases be planned in?
- Concluding reflection and systematisation of the acquired knowledge: How can the acquired knowledge be linked and structured into a systematic relationship? Are overarching (economic, environmental, social) implications also included in the reflection? How can the knowledge gained be transferred to other situations and what modifications would be required in this case?
- Assessment of learning achievement: What competences did the students develop within this learning situation (with separate evaluations of technical, social and personal competences on the one hand as well as their expression in terms of

communicative competence, methodological competence and learning competence on the other).

The reduction in statutory provisions in the framework curriculum creates space for didactic decisions in the classroom. However, these activity spaces must now be filled by the teachers and students, posing a large challenge for both sides. After the new concept was introduced, the slogan ‘from a thematic to a process supporter’ started becoming popular. However, this is an erroneous description of the situation – but it did provide an accurate representation that the role model had enriched. The teacher must remain the technical expert. In open, interactive situations, this may not and does not always have to be the case, however. The role extension therefore had an emotional dimension: being able to accept that a teacher does not always know all the answers beforehand, but may have to work at getting to the answer, where necessary, in class together with the students. The role extension also had a methodical dimension: besides the technical competence of design of the classroom in terms of content, now there is also the competence to moderate the discussion and learning process. These added requirements gave some teachers difficulties. Forms of resistance ranged from overt rejection of the new areas of learning to covert refusal by simply renaming old subjects into areas of learning, but maintaining the old form and content of the previous education system. Today, more than 20 years after the reform, the resistance has decreased considerably or completely disappeared. As to the extent of covert refusal or ‘internal resignation’, it is unclear how much of this still remains. No comprehensive studies have been published on this matter. It is to be expected, however, that forms of this type of resistance still exist.

32.5 Conclusions

Since the introduction of the areas of learning concept, a significant change took place in the school-based part of the dual system that led to the work-oriented turn. The new framework curricula are designed to orient areas of learning in school above all according to vocational spheres of activity. This reorientation means the distinction between ‘theory = school’ and ‘practice = company’ loses significance. Due to the Federal Republic of Germany’s federal structure and the shared jurisdiction of federal government (responsible for vocational training) and state government (responsible for school-based education), there continue to be two regulations (training regulations and framework curriculum), and, although they have been coordinated with one another since 1972, they are still governed by different authorities and therefore demonstrate differences. Perhaps these differences prevent school education from economisation and protect humanist values? Perhaps an integrated education and training regulation improve the overall quality of vocational education and training? As this has as yet not been implemented, possible consequences and side effects are unclear. The development since 1990 does, however, show that on the whole, not only has school-based vocational education and training moved closer to work but also that the vocational side has achieved an important educational objective by providing trainees with the skills to autonomously plan, implement and assess work tasks in the context of their vocation.

Crucial to all these questions is the used concept of competence: defining expectations in terms of outcomes has a lasting and structural-educational effect on training in companies and education in schools.

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